tions here considered is greater in winter than in summer, and inversely the distances of the anticyclonic centers are smaller in winter than in summer.

20. In the land and the coast cyclones the greatest angle of deviation occurs at distances of 444-666 and 1110–1554 kilometers, respectively; the smallest angle occurs in the immediate neighborhood of the center, and in land cyclones at a distance of 1110–1332 kilometers; in coast cyclones from 1554-1776 kilometers.

21. At medium altitudes, on the contrary, the zone of 444-666 kilometers radius shows a principal minimum; thence, the angle increases as we go inward as well as outward and, at the distance of 666–888 kilometers, attains its principal maximum only to decrease again as it approaches the periphery of the cyclone.

22. In cyclones near the coast and at medium altitudes, the zones of the greatest and smallest angle (α) at a distance of from 444–666 kilometers, form the boundary of a cyclinder of air around which the outer air moves in spirals; on land, however, the orographic impediments disturb these very much.

23. In coast cyclones, in the exterior space, the greatest ascension of the air takes place on the south side, whereas the tangential forces hinder the ascent on the rear side. On the other hand, in land cyclones, in which the air flows inward spirally close up to the center, the location of the greatest ascension is transferred to the immediate neighborhood of the center. In consequence of the orographic inequalities, the maximum of rainfall may be shifted.

24. At medium altitudes in the inner zone the movements toward the center continue for the most part unchanged, but in the outer zones and in front there is an energetic outflow.

25. In regard to the individual seasons, in cyclones over the land, both at the ground and at medium altitudes, the various zones of (α's) show a shifting of location, whereas in coast cyclones the increase and decrease of the average value of the angle (α) occur in almost the same manner in the summer and winter seasons.

26. The variation, from summer to winter, of the greatest outflow on the Schneekoppe, indicated in theorem 18, and the resulting change in the direction of propagation of the cyclones, occurs also for each individual distance from the center. Since (although preponderating in the outer zone) in the winter season the greatest outflow occurs with westerly gradients and in the summer season with southwesterly gradients.

27. The velocity of the wind increases both with increasing distance from the periphery and from the center of the cyclone and attains two maxima, one of which is near the center and the other, according to the location of the cyclone, lies between 900 and 1300 kilometers distant from the center. In summer the location of the first maximum of the force of the wind is shoved away from its usual location near the center.

28. In anticyclones, both on the coast and over the land, the smallest angle (α) is close to the center; the largest angles are in the second zone and at the periphery.

29. On the other hand, at medium altitudes the largest (α) angles occur at distances of 666 to 888 kilometers and at 1998 to 2220 kilometers; the smallest angles are close to the center.

30. In anticyclones on the land and in those on the coast in winter the air flows from the center toward all sides of the periphery in spiral curves; furthermore, during the summer season, in the anticyclones on the coast a tangential movement of the air is observable in the north and east quadrants.

31. At medium altitudes the air on the front side flows rapidly outward, whereas in the rear it has a tendency to flow inward.

32. In anticyclones the velocity of the wind increases with increasing distance from the center and, according to the location of the area of high pressure, it attains two maxima, one of which lies at a distance of 666 to 888 kilometers; the other is in the neighborhood of the periphery.

33. The median altitude of the anticyclones is greater than that of the cyclones.

34. The coefficient of friction on the earth's surface (the k of Guldberg and Mohn) decreases as the stations are located nearer to the coast and, also, as the elevation above the earth's surface increases.

METEOROLOGY IN THE SUMMER SCHOOLS.

The development of summer schools at various universities has become a very important factor in our educational scheme. There are probably a dozen large institutions, such as Harvard, Cornell, Chicago, Columbian at Washington, and the University of Virginia at Charlottesville, that have taken up this work with great enthusiasm and very important results. These summer schools are not rivals of the various Chatauquan Assemblies, nor of the normal schools in the national educational assemblies. They fill a different field; they are peculiarly adapted to be the means of introducing new ideas to the teachers and officers of normal schools. They bring the best teachers of graded schools and academies and smaller colleges where teaching is the main thought, into close contact with the most progressive spirit of education, that which seeks out new lines of thought and new ways of looking at familiar subjects, thus leading up to original thought and research on the part of the scholar. It must be acknowledged that the rapid progress of modern civilization, or man's conquest of nature has depended on the development of the habits of independent original, but logical, not erratic, research into the laws of nature. There are those who in such work wander off into attractive but delusive byways and fail to accomplish anything. Such were the "Paradoxers" of De Morgan. It is the province of modern education culminating in the modern university, to stimulate logical and sound, original and independent trains of thought and work. From this point of view the summer school is doing a fine work, and Weather Bureau men who are so situated as to be able to contribute six weeks of hard work to this educational campaign will doubtless be rewarded by finding their best ideas reappear in the normal schools and the graded schools of the country.

THE WEATHER OF THE MONTH.

By Mr. W. B. STOCKMAN, District Forecaster, in charge of Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart IV and the average values and departures from normal are shown in Tables I and VI.

The mean barometric pressure was highest over the immediate coast of the North Pacific States, with readings of 30.10 inches. Another, and extensive, area of high but slightly lower mean pressure overlay the Ohio Valley and Tennessee and the east Gulf and South Atlantic States. The mean pressure was lowest over southwestern Arizona, with a minimum reading of 29.75 inches at Yuma.

The pressure was above the normal in the Pacific States, western Nevada, the northern Plateau region, in the Gulf States, and the Ohio Valley generally, and Tennessee, and in parts of the Mississippi Valley, with the greatest departures on the northern coast of California; elsewhere the mean pressure was below the normal, with the maximum minus departures at northern New England stations, where they were about —. 10 inch.

The mean pressure for July, 1903, increased over June, 1903, in the Gulf and South Atlantic States, the southern portions of the Middle Atlantic States, the western part of the lower Lake region, the southern part of the upper Lake region, the Ohio Valley and Tennessee, the central Mississippi Valley, the Pacific States, and the western portions of the Plateau regions; elsewhere the mean pressure decreased from that of June, 1903. In the southeastern quarter of the country the increase was quite marked. The decrease in pressure was greatest from the northwestern portions of Texas and the Indian Territory northwestward over eastern Montana and northeastward over Lake Superior.

TEMPERATURE OF THE AIR.

The distribution of maximum, minimum, and average surface temperatures is graphically shown by the lines on Chart VI.

The average temperatures for the several geographic districts and the departures from the normal values are shown in the following table:

Average temperatures and departures from normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	8	67.4	− 0.7	+ 8.8	+ 1.3
Middle Atlantic	12	74.8	+ 0.2	+10.2	+ 1.5
South Atlantic	10	79.6	+ 0.5	+ 3.0	+ 0.4
Florida Peninsula*	8	81.5	+ 0.1	+ 4.5	+ 0.6
East Gulf	9	80.4	− 0.4	− 8.2	− 1.2
West Gulf	7	80.5	− 1.4	−10.5	− 1.5
Ohio Valley and Tennessee	11	77.2	+ 0.3	+ 2.7	+ 0.4
Lower Lake	8	70.7	− 0.5	+10.3	+ 1.5
Upper Lake	10	67.5	− 0.2	+13.9	+ 2.0
North Dakota*	8	67.0	− 1.9	+ 4.5	+ 0.6
Upper Mississippi Valley	11	74.8	− 0.4	+ 6.7	+ 1.0
Missouri Valley	11	74.8	− 0.4	+ 3.1	+ 0.4
Northern Slope	7	67.8	− 1.6	− 0.8	− 0.1
Middle Slope	6	77.5	+ 1.2	− 5.8	− 0.8
Southern Slope*	6	81.8	+ 1.9	−10.6	− 1.5
Southern Plateau*	13	76.7	− 1.9	−12.0	− 1.7
Middle Plateau*	8	68.4	− 3.0	−20.2	− 2.9
Northern Plateau*	12	65.5	− 2.6	+ 2.1	+ 0.3
North Pacific	7	59.3	− 2.0	− 2.9	− 0.4
Middle Pacific	5	62.0	− 2.5	− 7.3	− 1.0
South Pacific	4	68.2	− 2.4	− 4.9	− 0.7

*Regular Weather Bureau and selected voluntary stations.

The temperature was above the normal in southern New England, the southeastern portions of New York and Pennsylvania, New Jersey, from the Atlantic coast of Virginia, North Carolina, and northern South Carolina westward to central Colorado and western New Mexico, in the upper Rio Grande Valley, about southern Lake Michigan, in eastern upper Michigan, and lower Michigan, except the south-central part, but nowhere did the departure equal an average of + 3° per day; elsewhere the mean temperature was below the normal, with decided departures, ranging from an average of 2° to 5.9° per day in Idaho, Nevada, Washington, Oregon, northern and central California, southwestern Montana, and the western portions of the Dakotas; and 2.5° to 3.5° in portions of southeastern Texas. By geographical districts the temperature was above the normal in the Middle and South Atlantic States, Florida Peninsula, Ohio Valley and Tennessee, and the middle and southern slope regions, and below the normal in the remaining districts.

The isotherms of 70° and 80° of mean temperature were located somewhat to the southward of their positions in July, 1902, and mean temperatures of less than 80° were reported from portions of the interior of southeastern Texas, and southwestern Arkansas.

The area embraced by the isotherms of 100° and 110° of maximum temperature is much less than it was in July, 1902, and the isotherms lay to the southward. The isotherms of minimum temperature also lay to the southward of the positions they occupied in July, 1902, and this is markedly so with reference to the isotherm of 70°, and also of 60°, except in portions of the central Mississippi Valley. Freezing temperature was reported from northwestern Wisconsin.

In Canada.—Prof. R. F. Stupart says:

The temperature was below the average throughout Canada, except at a few isolated places in the Peninsula of Ontario where the average was either maintained or slightly exceeded. The negative departure was as much as 4° in portions of southern Alberta and southern Assiniboia, and 3° in many parts of British Columbia, but elsewhere from 1° to 2° was the usual departure from the average.

PRECIPITATION.

The precipitation was above the normal in central and eastern Texas, central and southwestern Arkansas, southern Louisiana, western and west-central Florida, southern New Jersey, extreme northern Maryland, District of Columbia, western Pennsylvania, extreme western New York, northern Ohio, Michigan, except the extreme western and south-central portions, Wisconsin, northern Illinois, Iowa, southern Minnesota, southern and western South Dakota, western North Dakota, central Nebraska, north-central Kansas, Montana, northern Idaho, Washington, except on the immediate Pacific coast, and in portions of western Colorado, northern Arizona, and southern Illinois; elsewhere it was below the normal. In southeastern Texas the excess of precipitation was nearly 11.0 inches, and nearly 7.0 inches in southeastern New Jersey.

By geographic districts the precipitation was normal in the middle and south Pacific districts, slightly above in the Middle Atlantic States, upper Mississippi Valley and northern slope, and considerably above in the Lake region and west Gulf States; elsewhere it was below the normal, and except in the Ohio Valley and Tennessee, and the middle and southern slope districts the departures were slight. Rainfall ranging from 10.0 inches to 16.4 inches occurred in portions of southeastern Texas, south-central Louisiana, southwestern Florida, and southern New Jersey. Practically no rainfall occurred in California and Nevada.

The distribution of total monthly precipitation is shown on Chart III.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	8	2.91	81	−0.7	+0.9
Middle Atlantic	12	4.58	107	+0.3	+0.3
South Atlantic	10	3.62	61	−2.3	−0.2
Florida Peninsula*	8	5.73	88	−0.8	+5.4
East Gulf	9	5.09	91	−0.5	+0.6
West Gulf	7	6.92	229	+3.9	+2.9
Ohio Valley and Tennessee	11	2.65	64	−1.5	−2.3
Lower Lake	8	4.08	132	+1.0	+1.7
Upper Lake	10	4.97	152	+1.7	−0.7
North Dakota*	8	1.90	76	−0.6	−3.6
Upper Mississippi Valley	11	4.15	111	+0.4	−1.5
Missouri Valley	11	3.54	94	−0.2	+0.2
Northern Slope	7	2.45	148	+0.8	0.0
Middle Slope	6	1.88	65	−1.0	+0.4
Southern Slope*	6	1.51	50	−1.5	−2.0
Southern Plateau*	13	0.94	70	−0.4	+0.3
Middle Plateau*	8	0.53	84	−0.1	0.0
Northern Plateau*	12	0.89	75	−0.3	−3.6
North Pacific	7	0.86	90	−0.1	−6.7
Middle Pacific	5	0.01	100	0.0	−3.7
South Pacific	4	0.00	100	0.0	+0.4

*Regular Weather Bureau and selected voluntary stations.

In Canada.—Professor Stupart says:

The rainfall generally was above the average, and in many localities to a marked extent, but in certain small sections of the Dominion the fall was at the same time deficient. The sections, with the negative departure, were noticeably the western portion of the Province of Quebec, Prince Edward Island, and Cape Breton as well as a few scattered

points in Ontario, the Northwest Territories and on the coast line of British Columbia. Over the mainland of British Columbia the rainfall was much above the average, and between the 4th and 6th there was a snowfall of about 2 feet on the mountain ranges, extending to quite a low altitude for the season of the year. Southern Alberta was remarkable for its large rainfall, so also was the Qu'Appelle Valley, but the largest positive departures were in the Peninsula of Ontario, mainly no doubt attributable to heavy local thunderstorms. Port Dover was 5.9 inches above the average; Port Stanley, 4.1 inches above; Owen Sound, 3.3 inches above, and Toronto, 1.4 inches above. The positive departure was also marked in the Peninsula of Quebec, likewise in northern New Brunswick, and over the Island of Anticosti.

HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 26. Arizona, 8, 16, 22, 24. Colorado, 2, 3, 7, 9, 10, 13, 14, 16, 17, 18, 19, 20, 22, 24, 26, 27, 29, 31. Connecticut, 1, 14, 15, 20, 21, 26. Delaware, 22. Florida, 23, 24. Georgia, 7, 25. Idaho, 1, 6, 11, 16, 18, 22, 23. Illinois, 1, 11, 17, 21, 28, 29. Indiana, 2, 21, 22. Iowa, 8, 17, 20, 21, 26, 28, 29. Kansas, 1, 2, 3, 10, 11, 13, 15, 16, 29, 31. Kentucky, 11, 22. Louisiana, 12. Maine, 8, 15. Maryland, 3, 12, 20, 22, 29, 30. Massachusetts, 14. Michigan, 1, 2, 3, 11, 14, 17, 18, 19, 21, 28. Minnesota, 16, 27. Mississippi, 31. Missouri, 1, 20, 21, 23, 30. Montana, 1, 3, 6, 7, 13, 17, 19, 23, 24, 25, 26, 27. Nebraska, 3, 10, 11, 12, 13, 15, 20, 21, 23, 28, 29, 31. New Jersey, 2, 14, 20, 22, 29. New Mexico, 19, 28. New York, 14, 15, 20, 21, 29. North Carolina, 5, 23, 28. North Dakota, 9, 10. Ohio, 2, 14, 21. Oklahoma, 4. Oregon, 1, 2, 20, 23. Pennsylvania, 3, 4, 5, 11, 14, 15, 20, 22, 30. South Carolina, 22. South Dakota, 1, 2, 8, 9, 10, 11, 15, 20, 21, 25, 27, 28. Tennessee, 8, 9, 18, 19, 22, 28, 29. Texas, 11, 24. Utah, 6, 16, 24. Vermont, 15, 16. Virginia, 20. Washington, 1, 6, 8, 9, 22, 23. West Virginia, 3. Wisconsin, 1, 9, 28. Wyoming, 1, 2, 3, 17, 18, 24, 29, 30, 31.

SLEET.

The following are the dates on which sleet fell in the respective States:

Colorado, 3. Wyoming, 3.

HUMIDITY.

The relative humidity was normal in the middle slope district and Missouri Valley; below in the Atlantic States, Florida Peninsula, east Gulf States, and the southern slope, southern Plateau, and middle Pacific districts, and above normal in the remaining districts.

The averages by districts appear in the subjoined table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	78	— 2	Missouri Valley	66	0
Middle Atlantic	73	— 1	Northern Slope	61	+ 9
South Atlantic	76	— 4	Middle Slope	60	0
Florida Peninsula	79	— 1	Southern Slope	58	— 1
East Gulf	77	— 1	Southern Plateau	33	— 5
West Gulf	78	+ 4	Middle Plateau	34	+ 2
Ohio Valley and Tennessee	70	+ 1	Northern Plateau	49	+ 8
Lower Lake	72	+ 3	North Pacific	77	+ 2
Upper Lake	74	+ 2	Middle Pacific	65	— 1
North Dakota	67	+ 1	South Pacific	67	+ 3
Upper Mississippi Valley	69	+ 1			

SUNSHINE AND CLOUDINESS.

The cloudiness was in excess in New England, the Gulf States, Lake region, Missouri Valley, North Dakota, northern slope district, and the northern and middle Plateau, and Pacific regions; elsewhere it was below the average.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographical districts, appear in Table I.

The averages for the various districts, with departures from the normal, are shown in the following table:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.3	+ 0.4	Missouri Valley	4.5	+ 0.1
Middle Atlantic	4.2	— 0.6	Northern Slope	4.3	+ 0.5
South Atlantic	3.8	— 1.2	Middle Slope	3.7	— 0.3
Florida Peninsula	4.9	— 0.1	Southern Slope	3.7	— 0.1
East Gulf	5.2	+ 0.2	Southern Plateau	2.4	— 0.9
West Gulf	4.3	+ 0.1	Middle Plateau	2.2	+ 0.2
Ohio Valley and Tennessee	4.4	— 0.2	Northern Plateau	3.4	+ 0.3
Lower Lake	4.6	+ 0.1	North Pacific	5.6	+ 1.2
Upper Lake	5.0	+ 0.3	Middle Pacific	3.2	+ 0.3
North Dakota	4.4	+ 0.1	South Pacific	1.9	+ 0.8
Upper Mississippi Valley	4.1	— 0.2			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Amarillo, Tex	17	60	nw.	New York, N. Y	2	72	nw.
Chicago, Ill	4	70	s.	Do	11	54	nw.
Do	17	56	se.	Point Reyes Light, Cal.	1	74	nw.
Grand Rapids, Mich	4	56	sw.	Do	2	58	nw.
Green Bay, Wis	1	59	nw.	Do	4	57	nw.
Milwaukee, Wis	17	50	e.	Do	5	80	nw.
Minneapolis, Minn	2	58	ne.	Do	6	74	nw.
Do	9	60	nw.	Do	12	52	nw.
Modena, Utah	5	55	sw.	Do	13	52	nw.
Do	6	65	sw.	Do	18	53	nw.
Mount Tamalpais, Cal	1	60	nw.	Do	19	50	nw.
Do	3	57	n.	Southeast Farallon, Cal.	1	55	nw.
Do	4	60	nw.	Do	2	50	nw.
Do	5	71	nw.	Tatoosh Island, Wash	1	52	s.
Do	6	62	nw.	Toledo, Ohio	1	63	w.
Do	20	50	nw.	Williston, N. Dak	7	50	w.

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 8139 thunderstorms were received during the current month as against 8266 in 1902 and 6045 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country was most numerous were: 29th, 537; 11th, 468; 30th, 411; 10th and 22d, 383.

Reports were most numerous from: Missouri, 451; Nebraska, 439; New York, 393; Iowa, 358.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: 5th to 13th.

In Canada: Thunderstorms were reported at St. John, N. B., 10, 12, 17, 24, 26. Sidney, 2, 18. Grand Manan, 2, 23. Yarmouth, 10, 30. Charlottetown, 11, 12, 15, 18, 24, 26. Chatham, 16. Father Point, 7, 12. Quebec, 1, 8, 10, 11, 13, 14, 15, 16, 30. Montreal, 1, 7. Ottawa, 20, 21, 23. Kingston, 2,

21, 22, 23. Toronto, 3, 9, 11, 19. White River, 5, 18, 20. Port Stanley, 2, 3, 5, 11, 14, 19, 20, 21, 22, 29, 30. Saugeen, 3, 29. Parry Sound, 5, 15, 19, 20, 30. Port Arthur, 1, 19. Winnipeg, 9, 10, 15, 24, 27, 28, 29. Minnedosa, 5, 6, 20, 27. Qu'Appelle, 1, 7, 14, 15, 26, 27. Medicine Hat, 6, 7, 19, 24, 26, 29. Swift Current, 10, 14, 19, 20, 26, 27. Calgary, 26, 30. Banff, 12, 18, 22, 23, 26. Prince Albert, 22, 24. Battleford, 11, 23, 29, 30. Kamloops, 11, 23, 29, 30. Barkerville, 13. New Westminster, 13. Dawson, 16. Hamilton, Bermuda, 25.

An aurora was reported from Quebec on the 27th.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. W. B. STOCKMAN, Forecast Official, in charge of Division of Meteorological Records.

For description of tables and charts see page 286 of REVIEW for June, 1903.